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The purpose of this project is to conduct cost-effectiveness analyses (CEA) of three treatment alternatives (modified radical mastectomy, breast conserving surgery with radiation therapy, and breast conserving surgery without radiation therapy) for elderly women (67 and older) with early stage breast cancer. Data for the CEA will be obtained from surveys of breast cancer patients at three, four, and five years post-treatment, their surgeons, and Medicare's National Claims History File. (Data for women up to two years post-treatment will be obtained from a complementary resarch project.) Analyses of preliminary data from the physicians and patients in the related project were begun for the purpose of constructingthe final survey instruments. The samples of physicians and patients for the national surveys have been drawn from Medicare data for 1992-1994.

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Jacke Hadley Aug. 16, 1996

PI - Signature Date

Cost Effectiveness of Alternative Treatments for Local Breast Cancer in the Elderly

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I. INTRODUCTION

Nature of the Problem and Background

In 1994, 183,000 women developed breast cancer and 47,000 women died of the disease. Forty-four percent of the new cases and 56 percent of the deaths occurred among the 13 percent of the female population which was 65 or older. Thus, more than 80,000 elderly women are diagnosed with breast cancer each year and, based on increased use of screening examinations, upwards of 70 percent of these women should be diagnosed in local stages (Tabar et al., 1985).

As a consequence of this high burden of disease, the elderly incur a disproportionate share of the $35 billion in annual direct medical costs of cancer in the U.S. In addition, the cost of medical care to the Medicare program for breast cancer survivors is substantial. On average, breast cancer survivors live an additional 11.2 years and incur almost $54,000 in Medicare costs (Riley et al., 1995). Despite the enormous resources expended on cancer care, little is known about the financial impact of alternative cancer therapies.

Randomized clinical trials of breast cancer therapies conducted in the 1980s have demonstrated that breast conserving surgery (BCS) with radiation therapy (RT) yields equal survival to modified radical mastectomy (MRM) (Bader et al., 1987; Fisher et al., 1985; Fisher et al., 1989). However, few elderly women were included in those trials. Further follow-up of women in the trials indicates that survival rates for local stage disease continue to be equivalent for both treatment modalities, whether or not BCS is accompanied by RT (Early Breast Cancer Cooperative Group, 1995; Fisher et al., 1995). However, local recurrence rates are 30% higher in women who did not receive RT in conjunction with BCS compared to BCS with RT. Although age was not considered a contraindication to either treatment modality (Steinfeld et al., 1989; Balducci et al., 1991), there has been very little direct analysis of the effects of alternative treatment choices on survival or recurrence in the elderly.

In spite of the evidence from clinical trials, the use of BCS by elderly patients varies greatly and appears to be under-used. Estimates from the late 1980s indicate that only 3.5% to 21% of elderly women received BCS; fewer than half of these women received RT (Chu et al., 1987; Yancik et al., 1989; Silliman et al., 1989; Lazovich et al., 1991; Bergman et al., 1991; Farrow et al., 1992; Nattinger et al., 1992; Newcomb and Carbone, 1993). Numerous other studies have documented additional age-related variations in breast cancer treatment (Greenfield et al., 1987; Samet et al., 1986; Silliman et al., 1989; Chu et al., 1987; Lazovich et al., 1991; Bergman, et al., 1991; Farrow et al., 1992), including less aggressive use of intravenous adjuvant chemotherapies (Newcomb and Carbone, 1993; Silliman et al., 1989; Allen et al., 1986; Chu et al., 1987), despite similar rates of toxicities seen in younger patients (Begg and Carbone, 1992), and fewer consultations with medical or radiation ecologists in elderly compared to non-elderly women (Newcomb and Carbone, 1993).

The few cost-effectiveness analyses that have examined treatment of local breast cancer have focused on younger women (Smith and Hillner, 1993), and/or have used data from RCTs (Smith and Hillner, 1993; Hillner and Smith, 1991; Verhoef et al., 1991). The efficacy of treatment and cost observed under RCT conditions are not likely to replicate those expected in actual clinical practice, where the populations are more heterogeneous and treatments less intense (Eisenberg, 1989; Drummond and Davies, 1991; Smith, Hillner, and Desch, 1993). This concern may be particularly germane when addressing the elderly, because of their substantial diversity in health, functional status, and social support. In addition, few breast cancer trials have included elderly women, especially those aged 75 or more. Munoz and colleagues, using 1983-1984 charge data for a case series of 79 women treated in one hospital found BCS and RT to be 37% more expensive than MRM; however, surgeons' fees were 55% higher for the MRM than for the more conservative surgery (1986).

Goals and Methods of Approach

The goal of this project is to conduct cost-effectiveness analyses of three treatment modalities for breast cancer (MRM, BCS with RT, and BCS without RT) in elderly women with local disease. Benefits will be based on survival and quality of life measured annually up to five years post-treatment. Costs will be measured from the social perspective and will be based primarily on the direct costs of all medical care. Secondary analyses will consider various substrata of women, based on age (67-75, older than 75), initial health state (derived from comorbidities at time of diagnosis and prior medical care use), place of residence (urban or rural), marital status and living arrangement at time of treatment (alone, with spouse, with others), and hospital type (cancer center, other teaching hospital, nonteaching)

Actual practice may deviate from recommended guidelines for several reasons: elderly women's poorer health generally, preferences and quality of life assessments, fewer social supports, diminished socioeconomic status, transportation difficulties, and poorer access to high-volume breast cancer surgeons and radiation therapy centers. Prior research, which has typically examined only one or two of these elements and has not focused primarily on elderly patients, provides few insights on these questions. By conducting cost-effectiveness analyses that take these factors into account, the proposed project will assess whether elderly women, generally or in particular circumstances, are receiving sub-optimal patterns of care. If they are, our analyses of treatment choice determinants and of the relationship between treatments and outcomes will generate recommendations for policy changes to alter treatment patterns, as well as to provide information for developing clinical guidelines regarding preferred treatment choices under a variety of patient and environmental circumstances.

Data will be collected by telephone surveys of a nationally representative sample of 3,000 Medicare beneficiaries who were treated for local breast cancer between 1992 and 1994, and of

their surgeons. The patient and physician samples will be drawn from Medicare's 5% Standard Analytic File, which is a nationally representative random sample of all Medicare beneficiaries and the physicians who treated them. In order to obtain a final sample of 3,000 women, we anticipate contacting over 4,000 physicians in order to request information about 6,000 beneficiaries. The combination of physician nonresponse, patient ineligibility, and patient nonresponse will result in the final sample of 3,000 patients.

The physician survey will be administered by mail with telephone follow-up beginning in October/November 1996. The patient survey will be conducted by telephone in the Spring of 1997, when the sample will be between three and five years post-treatment. Physicians will be surveyed in order to verify that the patient in fact had breast cancer and to determine the stage of disease. Women with late stage (III or IV) disease are not eligible for the analysis. Medical care use data will come from the Medicare National Claims History file for all respondents, nonrespondents, and decedents. (Cost data for decedents will be used in calculating cost-effectiveness ratios.) The relationship between treatment and outcomes will be estimated using an approach to correct for bias due to the observational nature of the data.

Data for women who are up to two years post-treatment will come from a complementary project (Care, Costs, and Outcomes of Local Breast Cancer, AHCPR Grant No. HS08395), which is supporting the collection of data for approximately 1,000 breast cancer patients who are being followed prospectively for up to two years. (The costs of the national physician and patient surveys are being shared by the two projects.)

Cost-effectiveness analysis will be used to combine the costs and outcomes of treatment over the five year evaluation period. Cost-effectiveness ratios will be constructed based upon the formula $CER_t = \Sigma\ Costs_t / \Sigma\ QALYs_t$ where t=treatment modality (MRM, BCS w/RT, BCS w/o RT). Costs are calculated from Medicare claims and QALYs are calculated from five-year survival curves

for each of the three treatment outcomes and patient preference assessments (based upon adjusted patient EuroQol© scores) at approximately years 1, 2, 3, 4, and 5. Preference assessments for time periods between measurements will be interpolated linearly, or extrapolated on a patient age-adjusted basis. We shall then divide the treatment survival curve for each of the three therapies into five 12 month segments. We will multiply the average patient months of survival for each portion of the survival curve by the average preference weight for that time period to develop a measure of the total preference-adjusted survival months for each segment of the survival curve. The number of QALYs for each of the three therapies will be taken as the discounted sum of the preference-adjusted survival months of the five curve segments. This method will account for survivor bias in responses to the preferences instruments because we will include all patients in the calculations, with patients who die having a preference weight of 0 from the date of death to the end of the observation period.

II. PROGRESS DURING YEAR TWO

A. Integration with the AHCPR Grant "Care, Costs and Outcomes of Local Breast Cancer" (HS08395)

As was documented in the Year One Annual Report, this project substantially complemented another grant from the Agency for Health Care Research and Policy. Because of this complementarity, work on this grant was suspended for a substantial portion of Year Two while the scope of work, time schedule, and annual budgets were revised in order to maximize the quantity and quality of the work that would be conducted under the two separate grants when viewed as a whole. The revised scope of work and budgets were submitted on May 1, 1996 and subsequently approved by letter on August 5, 1996. The period of performance for the entire project was extended from July 31, 1997 to July 31, 1998 with no additional costs requested in

order to coordinate the data collection and analysis activities of the two grants. Based on verbal authorization from the DoA Project Officer, work on this project was resumed in May 1996 consistent with the revised scope of work.

B. Work Conducted During Year Two

1. Development of the Survey Instruments for the National Physician and Patient Surveys

Work began on developing the national physician and patient survey instruments by analyzing preliminary data for 40 physicians and 90 patients who completed interviews as part of the longitudinal cohort data collection (supported by the AHCPR grant). Emphasis has been given to the physician data, since that survey will be conducted first. The preliminary results suggest that the three case scenarios do a very good job of identifying physicians by their propensities to recommend breast conserving surgery (BCS) relative to modified radical mastectomy (MRM), and for those recommending BCS, also recommending radiation therapy (RT). The two scenarios constructed to identify BCS and MRM propensities split almost evenly, with 20 physicians recommending BCS, 16 recommending MRM, and 4 splitting their recommendations. The RT scenario produced 27 respondents recommending BCS with RT, 10 recommending only BCS without RT, and only 2 recommending MRM.

Validation of the propensities is continuing and also looks very promising. Physicians who tend to BCS report that 69% of their patients received BCS, compared to 52% of the patients who tend to MRM. Analyses of the questions pertaining to Treatment Priorities and Patient Priorities reveals that a subset of the questions also appear to be associated with treatment propensities. Pending the results of further analyses, this reduced set of questions will be retained for the national survey.

Analysis of the patient data is focusing on the choice of an instrument for measuring quality of life at the time of the interview, and on identifying key demographic information that cannot be obtained from Medicare records. Very initial comparisons suggest that education, marital status, income, and assets (home ownership) are significantly related to the choice of BCS and, therefore, are important to include on the national patient survey.

2. Draw the Samples for the National Physician and Patient Surveys

A request for data on Medicare beneficiaries who may have been treated for breast cancer between 1992 and 1994 was submitted to HCFA through the Agency for Health Care Policy and Research on February 21, 1996. The data were received on May 20, 1996. A potential breast cancer patient was defined as any beneficiary who received a surgical procedure consistent with the treatment of breast cancer. Claims were drawn from both the inpatient hospital Medicare file (Part A) and the outpatient hospital and physicians' offices and clinics files (Part B). Data were requested from the 100% National Claims History File for 1994 and from the 5% Standard Analytic Files for 1993 and 1992. The subsequent sample for 1994 was also drawn from the 5% subset of the 100% file. However, the 100% file was used to create the appropriate weights for the physicians and patients selected.

As is described in detail in Appendix 1, a series of screens were developed to exclude ineligible patients. This process revealed that approximately a third of the potentially eligible patients (27,661 of 81,060 in 1994) did not have a diagnosis of breast cancer on any of their claims. Our suspicion is that the majority of these patients received biopsies or other forms of breast conserving surgery that resulted in a negative diagnosis. (A portion of these patients will be included in the national physician survey to validate this assumption.) Table 1 of Appendix 1 summarizes the exclusion process for each year of data and reports the final sample sizes.

The drawing of the sample also revealed that the distribution of patients across surgeons is very "flat," that is, most physicians who performed breast surgery on Medicare beneficiaries over this time period saw a relatively small number of patients. (Tables 2 and 3 of Appendix 1.) Of 5,671 unique physicians identified in the sample selection process over the three years, 4,227 (75%) saw only 1 sample patient. Since the average number of sample patients per physician is smaller than had originally been estimated, it is likely that we will have to survey more physicians in order to reach the target number of patient interviews. (We are currently exploring with Mathematica Policy Research, Inc., the survey subcontractor, the cost implications of a larger physician survey and ways in which costs can be economized on other portions of the survey methodology. A memo on this issue will be submitted before the end of October 1996.)

3. Request Additional HCFA Data

Memos were submitted to HCFA through AHCPR on July 22, 1996 requesting permission to use physician identifying information, a letter from the HCFA Administrator to sample physicians, and identifying information for sampled beneficiaries. The latter is needed for inclusion with the physician survey in order to verify patients' breast cancer diagnosis and disease stage.

4. Preliminary Analysis of State Hospital Discharge Data

An analysis was completed of state hospital discharge data for 1988 and 1991 from five states that provide information on all hospital discharges in the state and identify patients' source of insurance coverage. The purpose of this preliminary analysis was to explore the importance of insurance coverage and of travel distance as predictors of women's choice of BCS vs MRM. The analysis was limited to women under age 65 in order to examine the effect of different types of insurance coverage, since almost all elderly women during this time period were covered by

Medicare and HMO coverage of the elderly was relatively uncommon. Although the results vary somewhat from state to state, they suggest that HMO enrollees are less likely to receive breast conserving surgery and that they have shorter hospital stays, regardless of the type of surgery received. With regard to travel distance, women who live more than 15 miles from a hospital with an ACS-approved cancer program are less likely to receive BCS.

A manuscript describing the analysis and results was prepared and submitted for publication to Inquiry. A copy of the manuscript is attached as Appendix 2.

C. Conclusions

The restructuring of the scope of work and time schedule of this project to increase its complementarity with the AHCPR grant has resulted in a larger, more up to date, and statistically more powerful research project. Work during Year Three will concentrate on completing the survey instruments and conducting the national physician and patient surveys, constructing the area level data that will be used in the analyses, and beginning the process of obtaining cost data for cost effectiveness analyses that will begin in Year Four.

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MEMORANDUM

TO: Jack Hadley
FROM: Andy Epstein
DATE: 25 June 1996
RE: Breast Cancer 1994 Sample Creation

This memo specifies the process which I followed to create the initial 1994 breast cancer project samples. This information is based on work I did in the /home/epsteina/breast/setsamp3.sas SAS program.

The baseline SAS files Qin converted from HCFA's raw data tapes are stored in the /data1/qwang/breast subdirectory at Worthen. The 1994 inpatient file is ME5264.ssd01, the 1994 outpatient file is ME5268.ssd01, and the 1994 Part B (Phys supp) file is ME5300.ssd01.

First, the three bill files were combined and sorted by bene_hic, the unique patient identifier, and from_dt, the date the services on each bill were started. The universe of potential patients started at 199,218. All bills for each patient were examined and checked to ensure that the patient met the non-exclusion criteria. The criteria are as follows:

1. **BCFLAG** - If any of the nine or ten diagnosis fields (there are ten on the inpatient and outpatient bills, but only nine on the Part B bills) (diag1-diagx) on any bill for a patient includes the code 174, then the patient is classified as having breast cancer. Additionally, if the patient is lacking the diagnosis code, but has an inpatient bill with any of the codes 257, 258, 259, 260, 274, or 275 present in the DRG field (drg_cd), then the patient is also classified as having breast cancer.

2. **UPFLAG** - If each of a patient's bills contains an empty (missing) UPIN field (upin), then the patient is excluded for not having a UPIN. (3,415 were excluded.)

3. **SEXFLAG** - If the sex fields (sex_cd) on all bills indicate male (1), then the patient is excluded for being consistently male. (19,350 were excluded.)

4. **AGEFLAG** - The layout for the date of birth field (dob) is YYYYMMDD. Age is calculated as 1994 - year born (the first four digits of dob = floor(dob/10000)). If the age variable is less than 67 for every bill, then the patient is excluded for being consistently underage. (28,247 were excluded.)

5. **CISFLAG** - If any of the diagnosis fields (diag1-diagx) on any bill for a patient includes the code 233, then the patient is excluded for having the CIS diagnosis. (5,882 were excluded.)

6. **METFLAG** - If any of the diagnosis fields (diag1-diagx) on any bill for a patient starts with the first three digits 196 and has a fourth digit that is 2, 5, 8, or 9, then the patient is excluded for having a metastases diagnosis. (1,097 were excluded.)

7. **BILFLAG** - If any of the procedure code fields (proc1-proc10) for an inpatient or outpatient bill (there are no procedure codes on Part B files) has the codes 8542, 8544, 8546, or 8548, then the patient is excluded for having a bilateral procedure. (139 were excluded.)

8. **HISFLAG** - If any of the diagnosis fields on any bill starts with the three digits v10 or V10, the patient is excluded for having a history of cancer diagnosis. (8,916 were excluded.)

9. **SURFLAG** - If none of the procedure code fields (proc1-proc10) has the codes 8520, 8521, 8522, 8523, 8541, 8543, 8545, or 8547, and if none of the HCPCS fields (hcpcs1-hcpcs28) includes the code 19180, 19182, 19200, 19220, or 19240, then the patient is excluded for not having a surgical procedure. (7,955 were excluded.)

10. **FSTFLAG** - For those patients remaining not classified as having breast cancer (see BCFLAG), if none of the first procedure code fields (proc1) contains the codes 8520, 8521, 8522, 8523, 8541, 8543, 8545, or 8547, and none of the first HCPCS fields (hcpcs1) contains the codes 19120, 19160, 19162, 19180, 19182, 19200, 19220, or 19240, then the patient is excluded for not having an acceptable first procedure or HCPCS code. (32,201 non-breast cancer patients were excluded.)

At this point, the sample contains 92,016 patients and their bills. This set was merged with the Empire file (/data11/qwang/phymst.ssd01), the HCFA master file of physicians, by the UPIN field. (N.B., the Empire file contains multiple physicians per UPIN, so the most recent records only were used, according to the assignment date field (asgn_dt).) For patients who had multiple UPINs (on multiple bills), if a UPIN didn't match to the Empire file, its UPIN and specialty information were replaced with information from the first previous bill with matched and valid UPIN and speciality information. The patient-bill set was sorted by bene_hic, and examined on a per patient basis for further exclusionary criteria.

To pass this stage, a patient had to:

- have at least one bill with a UPIN that matched to the Empire file and at least one specialty code field (spclty1, spclty2) that was not a Group code (70 through 74 inclusive), and
- have at least one bill from a physician had at least one specialty code field that contained 91 (Surgical Oncology) or 02 (General Surgery).

(10,956 were excluded.)

The final sample contained a final total of 81,060 patients, of whom 53,399 are classified as breast cancer patients, and 27,661 who are not.

Table 1

BREAST CANCER PROJECT
SAMPLE CREATION TRACE
July 11, 1996 - FINAL
/home/epsteina/breast/Setsamp3.sas

	1994 Full	1994 5%	1993 5%	1992 5%
Initial Unique Patients (bene_hic)	199,218	10,010	10,714	11,484
- missing UPIN (upflag)	- 3,415	- 143	- 97	- 205
- consistently male (sexflag)	- 19,350	- 954	- 907	- 1,034
- age consistently less than 67 (ageflag)	- 28,247	- 1,404	- 952	- 586
- CIS diagnosis (cisflag)	- 5,882	- 297	- 260	- 322
- metasteses diagnosis (metflag)	- 1,097	- 54	- 52	- 49
- bilateral procedure (bilflag)	- 139	- 1	- 4	- 3
- history of cancer diagnosis (hisflag)	- 8,916	- 462	- 512	- 472
- lack of any surgical procedure (surflag)	- 7,955	- 408	- 433	- 434
Subtotal	124,217	6,287	7,497	8,379
No acceptable first proc or hcpcs (fstflag)	- 32,201	- 1,582	- 1,944	- 2,464
Subtotal	92,016	4,705	5,553	5,915
- no valid (matchable) UPINs AND no non-group UPINs (up2flag) AND primary physician grade not (1 or 2)	- 10,956	- 596	- 690	- 736
Total	81,060	4,109	4,863	5,179
Total Eligible With Breast Cancer	53,399	2,642	2,822	3,184
Total Eligible WithOUT Breast Cancer	27,661	1,467	2,041	1,995
Of Total Eligible W/Out BC:				
Number Seen BC MD	14,374	788	1096	1053
Number Seen Non-BC MD	13,287	679	945	942

Table 2

Summary of National Survey Sampling Frame

Years in Sample	BC Diagnosis		No BC Diagnosis	
	UPINs	Patients	UPINs	Patients
All Three Years				
1992	221	304	73	104
1993	221	294	73	116
1994	221	276	73	106
Total	221	873	73	326
Two Years				
1992	(395+485)[a]	1,085	(104+183)[a]	392
1993	(343+485)	1,011	(183+123)	411
1994	(395+343)	893	(123+104	265
Total	1,223	2,989	410	1,068
One Year Only				
1992	1,573	1,795	473	557
1993	1,339	1,517	501	569
1994	1,315	1,469	359	407
Total UPINS	5,671		1,816	
Total Patients		8,644		2,927
1992		3,184		1,053
1993		2,822		1,096
1994		2,638		778

a. Identical UPINs appear in two of the three years.

Table 3

Distributions of Patients by
Physician UPIN and Years in Sample

Patients per Physician and Years in Sample	Number of UPINs	
	BC Diagnosis	No BC Diagnosis
All Three Years		
3	106	27
4	69	18
5	23	9
6	9	10
7	5	7
8	6	0
9	1	1
10	1	1
13	1	
Two Years: 1992 + 1993		
2	328	107
3	123	52
4	21	11
5	9	4
6	2	5
7	2	2
8	0	1
10	0	1
Two Years: 1992 + 1994		
2	256	66
3	109	26
4	21	9

Patients per Physician and Years in Sample	Number of UPINs	
	BC Diagnosis	No BC Diagnosis
5	6	3
6	3	
Two Years: 1993 + 1994		
2	232	72
3	81	36
4	23	11
5	3	3
6	4	0
7	0	1
One Year: 1992		
1	1,380	399
2	170	66
3	20	6
4	2	2
7	0	1
One Year: 1993		
1	1,191	440
2	173	56
3	20	4
4	5	0
5	0	1
One Year: 1994		
1	1,183	316
2	113	35
3	17	8
4	1	0
5	1	0

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The Effects of Insurance Coverage and Travel Distance on Nonelderly Breast Cancer Patients' Treatment Choices

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The Effects of Insurance Coverage and Travel Distance on Nonelderly Breast Cancer Patients' Treatment Choices

Abstract

This study uses hospital discharge abstract data from five states (MA, NY, NJ, MD, and CA) for two years (1988 and 1991) to investigate whether insurance coverage, especially enrollment in an HMO, and distance to a cancer hospital affect nonelderly breast cancer patients' treatment choices. The results are relevant to three questions: (1) Does HMO enrollment affect the pattern of care received; (2) does the availability of a specialized cancer facility encourage the use of breast conserving surgery (BCS); and (3) do women's decisions about where to receive treatment provide information about the importance of perceived hospital quality? Although the results vary from state to state, they indicate that HMO enrollees are less likely to receive breast conserving surgery and have shorter hospital stays, but are more likely to use a cancer hospital. Women who live more than 15 miles from a cancer hospital are less likely to receive BCS in a geographically large state. However, women who are distant from a cancer hospital are more likely to bypass the nearest cancer hospital and to receive BCS from a more distant hospital. Since the bypassed cancer hospitals are smaller and have fewer medical residents, it appears that women who travel for care both exercise a preference for BCS and are sensitive to perceived hospital quality.

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I. INTRODUCTION

A major question in the debate over whether HMOs and managed care are "good" for the American health care system is how they affect the care received by enrollees when they become sick. A few studies have examined data for relatively small numbers of patients in a limited number of practice sites (Greenfield et al., 1995; Miller and Luft, 1994; Carlisle et al., 1992). Although a definitive, global answer to this question may not be possible until much more data are available on the experiences of people enrolled in HMOs, it is nevertheless important to continue to address this issue with available data to help identify the dimensions of possible differences in care received by sick people covered by different types of insurance arrangements. Moreover, given the potential for variations across different types of conditions and diseases, it is important that this question be addressed on a disease-specific basis in order to provide a clearer interpretation of differences that may or may not exist. For example, if HMO patients do better for some conditions but worse for others, an analysis that does not account for cross-condition variations might wrongly conclude that there are no differences. Even if true on balance, the goal of seeking better medical care for those who do worse under one system or the other would not be served.

The objective of this study is to contribute to this debate by analyzing the relationships between type of insurance coverage and care received for nonelderly women with breast cancer. Using hospital discharge data from five states for two years (1988 and 1991), we first test whether insurance coverage affects the treatment received, breast conserving surgery (BCS) or modified radical mastectomy (MRM). Then, given treatment choice, we examine whether there are any variations associated with type of insurance and two proxy measures of the possible quality of care received, and a measure of resource consumption. The proxies for quality of care are whether treatment was obtained at a hospital with a cancer center approved by the American College of Surgeons and, if it was, whether it was the cancer center hospital nearest the woman's zip code

of residence. The resource use measure is the length of stay in the hospital, given treatment choice.

The analysis is embedded in a more general framework that controls for the effects of other nonclinical factors and limited measures of the patient's clinical condition. In particular, we also focus on the role of travel distance to the nearest cancer hospital. This variable is potentially important for two reasons. First, it should reflect time and convenience costs in the care decision, and, as such, may capture the influence of access to and/or availability of purportedly better quality care on treatment decisions. Second, since breast cancer care is typically not provided under emergency conditions, it may be possible to make inferences about women's demand for quality care by examining their choices of where to actually receive treatment.

Understanding the determinants of treatment choice for breast cancer is particularly important because breast cancer is the most common form of cancer and the second leading cause of death among women. Moreover, results from several randomized clinical trials conducted in the 1980s have shown that BCS followed by a course of radiation therapy (RT) is equivalent to MRM in terms of survival (Veronsi et al., 1981; Sarrizan et al., 1983; Bader et al., 1987; Fisher, et al., 1985; Fisher et al., 1985; Fisher et al., 1995; Collaborative Trials Group, 1995). In 1990, the NIH recommended that breast conserving surgery accompanied by lymph node dissection and radiation therapy be the preferred treatment for localized breast cancer, except in cases of multicentric disease or expected poor cosmetic results (NIH, 1991). Despite these recommendations, the use of BCS varies widely and tends to be underutilized.

Empirical evidence suggests that patient, provider, and regional factors influence treatment choice for breast cancer. Previous research indicates that the probability of BCS declines with age and stage of disease (Lazovich et al., 1991; Muss et al., 1992; Osteen et al., 1992; Satariano et al., 1992), whereas better educated and higher income women are more likely to received BCS

relative to MRM (Lazovich et al, 1991; Muss et al., 1992). Further, the use of BCS is higher in the Northeast and Pacific regions, and is more likely to be performed in large and/or teaching hospitals (Satariano et al., 1992; Lee-Feldstein et al. (1994)). Relatively few investigations have examined black/white differences in treatment choice for breast cancer and these results are mixed (Nattinger et al., 1992; Farrow et al., 1992). Finally, to our knowledge, only three studies have analyzed the effect of insurance coverage on treatment choice (Muss et al., 1992; Ayanian et al, 1993; Johantgen et al., 1995). Their findings indicate that self pay and publicly insured women are less likely than women covered by private insurance to receive BCS relative to MRM.

Although previous research offers some insights regarding the influence of nonclinical factors, the findings have only limited generalizability and implications for policy. First, no prior research on treatment choice has compared women enrolled in HMOs to women with other types of insurance. Second, previous studies have not considered the effects of travel distance, a potentially important indicator of both time price and women's preferences for treatment choice. Third, all of these studies are based on data which predate the NIH recommendation. Other limitations include a reliance on bivariate analysis only, small sample size, and the age composition of the sample analyzed. Finally, we are not aware of prior studies that have evaluated whether nonclinical factors influence the quality and quantity of care received.

We analyze the determinants of treatment choice for breast cancer for women aged 40 to 64 using 1988 and 1991 hospital discharge data from five states: California, Maryland, Massachusetts, New Jersey, and New York. Each of these states' databases identifies HMO insurance coverage, the patient's zip code of residence, and race and/or ethnicity, as well the surgical procedure received, the presence of other diagnoses, and the length of stay in the hospital. In addition, the New Jersey data for 1991 include information for women treated in hospital outpatient departments. Since BCS is increasingly performed as an outpatient procedure, this data

provides an important opportunity to test the sensitivity of the findings to the inclusion of outpatient data.

Another factor not considered by prior research in this area is that the price to the patient for a specific medical treatment includes a time component. Since the money price is generally trivial for persons with good insurance, the time price may sometimes be an important determinant of treatment choice. Previous research has measured time price in terms of travel distance from home to the array of available hospitals (see for example, Bronstein and Morrisey (1991)). If all hospitals provided both MRM and BCS of uniform quality, one would expect patients to choose the closest hospital. Yet, since perceived hospital quality varies widely by geographic market, patients may opt to obtain treatment at a more distant hospital which they consider to be of higher quality than the closest facility. Findings from the few studies that have examined the service areas of rural hospitals suggest that rural patients requiring specific procedures or those deemed to be complicated cases are more apt to be treated at urban hospitals (Kane (1978); Mayer (1983); Hogan (1988); Morrisey et al. (1988)). Moreover, if travel distance has a significant impact on breast cancer treatment choice, then this may be indicative of patients' preferences for one mode of treatment over the other.

II. CONCEPTUAL FRAMEWORK AND EMPIRICAL MODEL

Although considerable research has examined the effects of HMOs on costs, insurance premiums, hospital admissions, and length of stay, little research has focused on the choice of treatments for persons with specific medical conditions. More generally, the extent and type of insurance coverage can potentially influence provider recommendations as well as patients' preferences for specific medical treatments. For example, Young and Cohen (1991) found that heart attack patients in Massachusetts who were covered by HMO insurance were less likely than

patients covered by indemnity insurance to receive either arteriography or coronary bypass. However, HMO insurance status had no impact on subsequent mortality. Given the rapid growth of HMO enrollment, it is important to assess whether this type of insurance coverage affects breast cancer treatment choice.

The conceptual framework underlying our empirical analysis of treatment choice for breast cancer assumes that patients compare expected utilities associated with potential treatment choices, which, given our data, are two inpatient surgical procedures, breast conserving surgery (BCS) and modified radical mastectomy (MRM). Abstracting from the effects on utility of other consumption goods and leisure, expected utility depends on the full price to the patient of each treatment and expected outcome. Full price is a combination of out-of-pocket financial expenditures and time/inconvenience costs. Expected outcome depends on the patient's initial health status and clinical condition, and the recommendations/expert advice of the patient's physician. Finally, given identical combinations of full price and expected outcome, different patients will choose different treatments because of variations in their underlying preference for one treatment over the other. Preference variations may arise because of differences in attitudes with respect to the cosmetic effects of MRM relative to BCS, differences in the ability or willingness to tolerate the effects of post-surgical radiation therapy, and concerns about sexual function. (Note that conceptually it is difficult to distinguish clearly between differences in expected outcomes and differences in preferences, since the effects of preferences may often work through the expectation of treatment outcome. However, this ambiguity is not critical for the empirical analysis.)

The full price of obtaining a medical treatment includes both monetary (out of pocket) expenses and time costs required to undergo the procedure and any related follow-up services. Both demand and supply factors influence the effect of money price, proxied by type of insurance coverage. From the demand perspective, one would expect patients to choose the procedure that

minimizes out of pocket expenses, other things equal. Previous research suggests that women with more generous private insurance are more likely to undergo breast conserving surgery (Muss et al., 1992; Ayanian et al., 1993).

Supply considerations, the preferences of physicians and perhaps third party payers, may either reinforce or weaken patient preferences (demand). For example, physicians involved in capitated arrangements may have a financial incentive to recommend the procedure for which the total cost of the episode of care is less expensive. Alternatively, if the surgeon is paid on a fee-for-service basis and the fee paid by each insurer differs for the two procedures, then the surgeon may be predisposed to recommend the more financially lucrative treatment. Although we suspect that such factors influence treatment choice, we have no information on either physicians' fees, insurers' payments or total episode costs for the alternative procedures. Hence, while money price is likely to be a significant determinant of treatment choice, we have no specific predictions regarding the direction of these effects.

The time price is the sum of the total time required to undergo the surgical procedure and subsequent follow-up treatments multiplied by the opportunity cost of time. Information on each woman's value of time (wage rate) and the total time involved in an episode of breast cancer surgery and follow-up treatments is not available. We focus instead on one element of time price, the travel distance in miles from each woman's zip code of residence to the nearest cancer hospital. If hospital quality for both procedures is equal, the model predicts that a woman seeking to minimize time costs will choose to undergo surgery at the nearest hospital, and that distance should be unrelated to treatment choice.

Previous research, however, suggests that hospital quality varies significantly across geographic markets. If perceived quality is an important consideration, and the quality of each procedure differs within a hospital, then patients residing in smaller cities and rural areas, may

bypass the closest hospital and opt to undergo surgery at a more distant, but higher quality hospital. To acknowledge such preferences for better perceived quality, we control for whether a woman bypasses the nearest cancer hospital to undergo treatment at a more distant facility. Although we have no a priori expectations regarding the effect of travel distance on choice of surgical procedure, a significant relationship may suggest both the existence of quality variations and the existence of preference for one procedure over the other.

The conceptual framework also predicts that factors which affect health production efficiency such as age, race, education, severity of condition, and comorbidities may be important determinants of treatment choice. Published evidence has shown that the use of breast conserving surgery declines with age (Lazovich et al., 1991; Muss et al., 1992; Osteen et al., 1992; Satariano et al., 1992; Johantgen et al., 1995). Although we anticipate that the use of BCS will vary by race and ethnicity, findings from previous investigations are mixed. Hence, we have no a priori expectations as to whether minorities are more or less likely to receive BCS relative to whites. Educational attainment may also influence treatment choice. If education enhances a woman's level of knowledge about health, disease and the appropriateness of medical care, then we predict more highly educated women will be more likely to opt for BCS. Because information on each woman's level of education is not available, we construct proxies based on the percentage of persons in each woman's zip code of residence who hold at least a bachelors' degree.

Breast conserving surgery is deemed to be the less appropriate treatment for women with more advanced stages of the disease. Although stage information is not available, we can identify whether each woman had axillary lymph node involvement. An enlarged or malignant axillary lymph node is regarded as evidence of local metastasis. Since BCS is generally only suitable for tumors less than 2 CM, we predict that women with axillary lymph node involvement are less likely to

undergo BCS. Furthermore, prior research has found that comorbidities, which are proxies for poor health status, are associated with lower use of BCS.

It is widely acknowledged that utilization rates of medical procedures vary significantly by geographic region. Analyses of small areas attribute this variation to differences in physician practice styles (Wennberg, 1987, 1989). The regulatory environment and degree of competition in the marketplace may also influence treatment choice for breast cancer. For example, the health care marketplace in California has fostered intense competition among insurance plans and hospitals. In contrast, at various times Maryland, Massachusetts, New Jersey and New York have been subject to hospital all-payer rate setting systems which by design should mitigate the effects of payment differential, that exist across insurers. Although we cannot measure these effects explicitly, their potential existence suggests that it is important to control for each woman's state of residence.

Another consideration that should affect practice patterns is the change in the NIH guidelines in 1990. The NIH Consensus Panel recommended breast conserving surgery as the appropriate treatment protocol for most women with stage 1 or 2 localized breast cancer. We predict, therefore, that women who underwent breast cancer surgery after the issuance of the guidelines are more likely to have received BCS. Finally, provider characteristics, such as availability of radiation oncologists in the market area and whether the hospital where treatment was actually received is a cancer center may influence breast cancer treatment choice. The availability of radiation oncologists is a proxy for the availability of RT facilities, and physicians practicing at cancer centers may be more aware of NIH recommendations than other factors. Thus, both factors may increase the likelihood of BCS.

III. DATA SOURCES AND SAMPLE ANALYZED

The data for this study come from three sources. First, hospital discharge data for the years 1988 and 1991 were obtained for five states: California, Maryland, Massachusetts, New Jersey, and New York. These states were chosen for the analyses because their discharge data identify HMO coverage as a potential primary source of payment. These data also contain information on patient gender, age, admission and discharge dates, zip code of residence, race/ethnicity, principal diagnosis, four possible secondary diagnoses, principal procedure, three possible secondary procedures, and the hospital where the surgery was performed. Data on hospital teaching status, bed size, and zip code were obtained from the American Hospital Association's Annual Survey of Hospitals. Data on educational attainment of persons living in each woman's zip code of residence were obtained from the 1990 Census of Population.

We adopted the inclusion/exclusion criteria outlined in Nattinger et al. (1992) and consulted with a radiation oncologist who specializes in the treatment of breast cancer to identify the samples of women in each state who underwent either BCS or MRM. The initial patient population was identified by selecting all female patients with a breast cancer diagnosis (ICD-9-CM diagnostic codes 174 through 174.9, 196.3, 198.81 and 233) and a breast cancer procedure (ICD-9-CM procedure codes 40.3, 40.51, 85.1, 85.11, 85.12, 85.19, 85.2 through 85.23, 85.4 through 85.48). Based on the recommendations of our radiation oncologist consultant, we also included women who were missing a breast cancer diagnosis code but who had an appropriate surgical procedure code. After identifying the initial patient base with this screening algorithm, we restricted the samples to women between the ages of 40 and 64 because HMO coverage was not clearly identifiable for Medicare beneficiaries in states other than California. We further refined the samples using the criteria established by Nattinger et al. (1992). Patients were excluded if the hospital discharge data indicated a procedure code for biopsy only (ICD-9-CM codes 85.11 or

85.12), or lymph node excision only (ICD-9-CM code 40.3), or bilateral reduction mammoplasty only (ICD-9-CM code 85.32), or other bilateral subcutaneous mammectomy only (ICD-9-CM code 85.36). Women with procedure codes for both breast conserving surgery and mastectomy were classified as mastectomy discharges.

We further refined these initial samples to eliminate observations with missing data on key variables. First, we excluded cases that could not be matched by zip code to the Census Bureau zip code file. Second, discharges for whom Medicare was designated as the primary payer were excluded because these women are disabled. Third, we excluded discharges with "other" insurance. Finally, we excluded cases where travel distance to the nearest hospital appeared to be an outlier. The cutoff distances were established at the 99th percentile of each state; 1000 miles for California, 500 miles for New York, 300 miles for Massachusetts, 200 miles for Maryland, and 125 miles for New Jersey. The final sample sizes were: California (13,655), Massachusetts (3,627), Maryland (2,835), New York (14,091) and New Jersey (11,104 total; 4,435 inpatient only).

IV. METHODS AND VARIABLE DEFINITIONS

The dependent and independent variables included in the treatment choice and length of stay regressions are defined in Table 1. The unit of analysis is the individual patient who underwent a surgical procedure for breast cancer during either 1988 or 1991 in one of the five states noted above. Because treatment choice (breast conserving surgery (BCS) versus modified radical mastectomy (MRM)) is a dichotomous dependent variable, we employ logistic regression. The dependent variable equals 1 for BCS and zero for MRM. Breast conserving surgery was defined as local excision, quadratectomy, or subtotal mastectomy (ICD-9-CM procedure codes 85.2 through 85.23 inclusive). Mastectomy encompassed unilateral simple, extended simple, radical or extended radical mastectomy (ICD-9-CM-procedure codes 85.41, 85.43, 85.45 and 85.47). In order

to separate the effects of insurance coverage on the decision to bypass the nearest cancer center, the decision to use a cancer center, and length of stay from the effects of procedure type, we estimated each of these models separately by treatment choice (BCS or MRM). Logistic regression is employed to analyze the dichotomous indicators of the decision to bypass the nearest cancer center and whether to undergo surgery at a cancer center.

The empirical specification follows the conceptual model outlined above. Money price is proxied by type of insurance coverage: HMO, Medicaid, or self-pay; relative to the reference category of Blue Cross or other private indemnity insurance. Travel distance to the nearest cancer center is measured by the distance in miles between the population centroids of the patient's zip code of residence and the zip code of the nearest cancer center hospital. Distance is transformed into a binary variable to distinguish women who reside more than 15 miles from the nearest cancer center. The bypass variable identifies those women who bypass the nearest cancer center to undergo breast cancer surgery at a more distant facility.

Educational attainment, measured by the percentage of persons living in each woman's zip code of residence with at least a bachelors degree was converted into four categorical variables based on quartiles of the distribution of this variable. (Specific quartile values vary across states; see Table 1). Patient age is measured in years. Race/ethnicity is controlled for by a series of dummy variables. The categories for Maryland, Massachusetts, and New Jersey are black, white and other. New York has another category to identify Hispanics while the California specification distinguishes Asians and Hispanics; the reference category is white. The presence of two or more comorbidities was identified by a dummy variable. The last patient characteristic is the presence of metastasis of the axillary lymph nodes, which is identified by a dummy variable. Year of surgery (1988 or 1991) is represented by a dummy variable equal to one for 1991.

Preliminary estimation of separate models for each state and subsequent F-tests rejected the hypothesis that parameter estimates are similar across states. Thus, to allow for the effects of unmeasured factors, especially differences in the regulatory environment, the competitive nature of hospital markets, and differences in the maturity and market positions of HMOs in each state, the statistical models were estimated separately. In addition, we estimated two versions of the models with data from New Jersey, one including both inpatient and outpatient data and one limited to outpatient data only. The purpose of estimating two models was to determine whether the exclusion of outpatient data for the other states may bias the parameters of the key independent variables. This is especially important because HMOs may have a greater incentive to use outpatient departments if they are less costly than inpatient facilities.

V. CHARACTERISTICS OF THE SAMPLES

Table 2 reports the mean values of the dependent variables and key independent variables, type of insurance and distance to the nearest cancer center, for California, New York, Maryland, Massachusetts and New Jersey. The rates of breast conserving surgery range from a low of 23.7% in California to a high of 41.1% in New York. (When the outpatient and inpatient discharges for New Jersey are combined, the rate of breast conserving surgery is 74.6%). With the exception of Maryland, it appears that, irrespective of surgical procedure, the majority of women in all five states bypass the nearest cancer hospital to undergo surgery for breast cancer at a more distant facility. The other indicator of quality, whether a woman receives treatment at a cancer center, varies from a low of close to 30% in Maryland to a high of nearly 80% in Massachusetts. The indicator of resource use--length of stay--also varies by state. Length of stay for BCS and MRM in California are quite similar about 2.1 and 2.7 days respectively. While length of stay for BCS in the other four states is quite similar to California, this is not the case for mastectomy. Average hospital stay for

mastectomy is 3.7 days in both New Jersey and Massachusetts, 3.9 days in Maryland and 5.2 days in New York.

The insurance status of women who undergo inpatient surgery for breast cancer differs substantially between California and states on the East Coast. A substantial majority of women in New York (82.9%), Massachusetts (72.4%), Maryland (76.7%) and New Jersey (83.2%) are covered by either Blue Cross or other private commercial insurance, compared to less than 47% of California women. The major reason for this disparity is that HMO coverage is much more widespread in California; almost 40% of women who undergo inpatient surgery for breast cancer are enrolled in an HMO. In contrast, only 6.2% of women in New York, 20% of women in Massachusetts, 13.7% of women in Maryland, and 8% of New Jersey women have insurance through an HMO.

In California, New York, and Massachusetts, more than 85% of women who undergo breast cancer surgery live within 15 miles of a designated cancer hospital. In New Jersey, the proportion of women is even higher; almost all women who receive breast surgery in New Jersey live less than 15 miles from a cancer center. The opposite holds for Maryland as only 71% of women reside within 15 miles of a designated cancer center. Except for New Jersey, the actual distance that women travel to undergo breast cancer surgery is similar across the states. Close to one-quarter of women in California, New York, New Jersey, and Massachusetts travel more than 15 miles for breast cancer treatment. In contrast, about 12% of women in New Jersey travel more than 15 miles to undergo breast cancer surgery.

VI. REGRESSION RESULTS

In total, we estimated seven separate regression models for each state (treatment choice for all patients, and, controlling for the use of either BCS or MRM, separate models for the use of

a cancer hospital, bypassing the nearest cancer hospital, and inpatient hospital length of stay), and two sets of models for New Jersey (with and without outpatient cases), for a total of 41 regression models. (Inpatient length of stay was estimated only with the inpatient data for New Jersey.) Table 3 reports the regression coefficients for the models estimated for one of the states in our analysis, California, for patients who received MRM. (Results for all other models are available on request.) Although the specific parameter values differ across states, these results are typical of the other models estimated. We summarize these results briefly in the next section, but then proceed to focus on the findings for the two key independent variables across all of the states in the analyses.

A. Summary of Regression Results for California

To illustrate the general results of each model specification, Table 3 reports the parameter estimates for the logistic regression predicting treatment choice, and for mastectomy patients, factors affecting use of a cancer hospital, the decision to bypass the nearest cancer hospital, and length of stay for one state, California.

The determinants of treatment choice (column 1) show that women on Medicaid, self-pay patients and HMO enrollees are less likely to receive BCS relative to those with either Blue Cross or private commercial insurance. Second, women who reside more than 15 miles from the nearest designated cancer facility are less prone to undergo BCS. In contrast, women who opt to bypass the nearest cancer center to obtain treatment at a more distant hospital are more apt to undergo BCS. Further, women residing in highly educated areas are more predisposed to opt for BCS. Although the odds of BCS are significantly lower among Asians relative to whites, other differences linked to race and ethnicity are trivial. The odds of BCS declines significantly with age and metastasis of the axillary lymph nodes, whereas the presence of comorbidities significantly increases the chances a woman undergoes BCS. Finally, the change in the NIH guidelines, which

is approximated by the year variable, and the availability of radiation oncologists in the local market area are associated with higher use of BCS.

The determinants of whether a woman receives a mastectomy at a designated cancer center are reported in column 2 of Table 3. Medicaid beneficiaries and HMO enrollees are more predisposed to undergo a mastectomy at a designated cancer center. This is also the case for women who reside more than 15 miles from the nearest cancer center. Higher educational attainment likewise appears to increase the odds that a woman receives treatment at a cancer center. In contrast, blacks and women of other races are less likely than whites, asians and hispanics to use a cancer center. The odds of undergoing a mastectomy at a designated cancer center are greater for women with comorbidities or metastasis of the axillary lymph nodes. Finally, the chances of that treatment was obtained at an ACS cancer hospital have increased over time.

Factors influencing whether a mastectomy patient chooses to bypass the nearest cancer center are reported in column 3 of Table 3. HMO enrollees and self-pay patients are significantly less likely to bypass the nearest cancer hospital relative to otherwise similar women with either Blue Cross or private insurance. Conversely, women who reside more than 15 miles from the nearest cancer hospital are more apt to bypass this facility and obtain treatment at a more distant hospital. Higher levels of educational attainment also have a positive significant effect on the decision to bypass, although this relationship is nonlinear. Racial and ethnic minorities are significantly less likely than whites to bypass the nearest cancer hospital to undergo a mastectomy. While metastasis of the lymph nodes significantly increases the odds that a woman chooses to bypass, the effects of age and comorbidities on this decision are trivial. As expected, greater availability of radiation oncologists in the market area significantly lowers the odds of bypassing the nearest cancer center.

The determinants of length of stay indicate that Medicaid beneficiaries have longer stays, while HMO enrollees have shorter stays relative to mastectomy patients covered by private insurance. Moreover, women who live farther from the nearest cancer center tend to have significantly shorter stays compared to those who live in close proximity. Blacks and hispanics tend to have significantly longer stays than whites, asians and women of other races. Length of stay is longer for women with comorbidities, yet surprisingly is shorter for those with lymph node involvement. As expected, length of stay has declined significantly over time.

B. Relative Odds of Breast Conserving Surgery Versus Mastectomy

Table 4 reports the odds ratios from the logistic regression model of treatment choice (BCS versus MRM) in each of the five states. Only the odds ratios for insurance and travel distance are presented. First, we find that insurance coverage, which reflects both patients' out-of-pocket costs and possible provider financial incentives, is a significant determinant of treatment choice. HMO enrollees in California, New York, and New Jersey are 81-85% less likely to receive BCS relative to women with either Blue Cross or private indemnity insurance. Women on Medicaid in California and New York are 67% and 80% as likely to undergo BCS compared to those with private insurance. In contrast, Medicaid beneficiaries in New Jersey are 1.4 times more likely to undergo BCS relative to privately insured women. The reduced odds of BCS are also evident for self-pay patients in California, Massachusetts and New Jersey who are on average 70% as likely to receive BCS relative to women with private insurance coverage.

Second, we find that women who reside more than 15 miles from the nearest cancer center are significantly less likely to undergo BCS in California (odd = 0.90) and in New York (odds = 0.78). In contrast, women in Maryland who reside more than 15 miles from the nearest cancer hospital are 1.2 times more likely to undergo breast conserving surgery. Third, only in California

and New York, are women who bypass the nearest cancer center to undergo treatment at a more distant facility more likely to receive BCS. In the other three states, bypassing the nearest cancer hospital is not significantly related to treatment choice.

Finally, the effect of excluding outpatient cases from the New Jersey sample was minimal, even though the total sample size was reduced from 11,104 for 4,435. Parameter values changed only in the second decimal place, if at all, and significance levels were unaffected.

C. Effects of Insurance Coverage and Travel Distance , Given Treatment Choice, on Dimensions of Quality

Table 5 reports the odds ratios showing the effects of insurance coverage and travel distance on the likelihood that a woman chooses to undergo breast cancer surgery at an ACS-approved cancer center. With the exception of women residing in Massachusetts, we find that irrespective of surgical procedure, women enrolled in HMOs are more likely than women with private insurance to receive breast cancer surgery at a cancer center. HMO enrollees who undergo breast conserving surgery are 2.20 as likely in California, 1.76 times higher in Maryland, and 1.30 times more likely in New York and New Jersey to use a cancer hospital. The chances that women with HMO coverage who opt to have mastectomies also choose to have the procedure performed at a cancer center are 1.8 times higher in California, 2 times greater in New York, 3.4 times higher in Maryland, and 1.3 times higher in New Jersey compared to women with other private insurance. In contrast, no consistent pattern emerges for either surgical procedure across the five states for either Medicaid beneficiaries or those classified as self-pay.

For both surgical procedures, we also find that women in all five states who reside more than 15 miles from the nearest cancer center are much more prone to obtain treatment at a hospital with a cancer center than those who reside less than 15 miles from the nearest center.

Among women who undergo BCS and live far from a cancer center, the chances they opt to receive treatment at a cancer center range from twice as likely in Maryland to 5.8 times higher in California. Among mastectomy patients who reside more than 15 miles from the nearest cancer center, the greater odds of using a cancer center are 2.3 times higher in Maryland to 6.2 times more likely in California.

Since the overwhelming majority of outpatient cases in New Jersey receive BCS, excluding those case from the MRM sample had no impact on the parameter estimates, but did affect the results for the BCS sample. Including outpatient cases increased the relative odds of using a cancer center for BCS patients with either HMO or Medicaid coverage, and reduced them for Self-Pay patients, and these differences all became statistically significant. Although the changes in parameter values were not large in magnitude, they all moved farther away from 1.00 (regression coefficient of 0).

Table 6 reports the effects of insurance coverage and travel distance to the nearest cancer facility, given treatment choice, on the relative odds of bypassing the nearest cancer hospital. Except in New York, HMO coverage has a trivial impact on the relative odds that women who opt for breast conserving surgery bypass the nearest cancer hospital. In New York, however, HMO enrollees who receive BCS are 72% as likely to bypass the nearest cancer hospital as women with private insurance. Among HMO patients who undergo a mastectomy, the odds of bypassing the nearest cancer center are significantly lower relative to privately insured women in California (85%) and New York (81%) but about 1.2 and 1.4 times higher in Massachusetts and New Jersey respectively. Relative to women with private insurance, Medicaid beneficiaries who undergo BCS in New York and New Jersey are significantly more likely to bypass the nearest cancer hospital; the increased odds are about 1.8 and 1.6 times higher in New York and New Jersey respectively. Medicaid beneficiaries who receive mastectomies are likewise more prone to bypass the nearest

cancer hospital; the increased odds are 1.8, 2, and almost 2.6 times higher in New York, Massachusetts and New Jersey respectively.

The effect of living more than 15 miles from a cancer center on the decision to bypass a cancer center was large and statistically significant in all five states. The relative odds ranged from 1.6 (Massachusetts MRM patients) to 4.5 (New York BCS patients). While they varied by more than a factor of 2 across states, the odds were very similar within a state for patients receiving the two types of treatments.

Again, excluding outpatients from the New Jersey sample altered the relative odds for the BCS patients, but not the MRM patients. Contrary to the decision to use a cancer center, however, significance levels did not change, nor was there any consistent movement away from or towards 1.0. In New Jersey, only Medicaid patients had a significantly different (and higher) relative odds of bypassing the nearest cancer center relative to women with indemnity-type private insurance.

In Table 7, we compare the bypassed facilities and the cancer centers actually used by women who opt to bypass the nearest cancer center along two dimensions of quality. In all five states, the cancer centers actually used by women who bypassed the nearest cancer center have significantly more beds and residents relative to the bypassed facilities. These findings lend support to the hypothesis that women choose to bypass the nearest cancer hospital in order to obtain treatment at a more distant facility which they perceive to be of higher quality.

D. Effects of Insurance and Travel Distance on Resource Use

Table 8 contains the regression estimates predicting length of stay (in logs) by treatment choice for California, New York, Massachusetts, Maryland and New Jersey. The control variables account for 9-13% of the variation in length of stay for women who receive BCS, and for 9 - 19% of the variation for women who had a MRM.

For the most part, insurance status is an important determinant of length of stay. Irrespective of state, length of stay among Medicaid women who undergo a mastectomy ranges from 11% more days in Massachusetts to 39% more days in New Jersey when compared to otherwise similar women with private insurance. Medicaid women who receive BCS had even longer stays relative to the reference group; the increase in hospital days for Medicaid women relative to those with private insurance is almost 35% in New York, 38% in California, 57% in both New Jersey and Massachusetts and 65% in Maryland.

The reverse pattern for women enrolled in HMOs. Shorter lengths of stay for HMO patients who undergo mastectomy is highly significant in all five states, and ranges from 6% in New Jersey to 12.5% in New York. While HMO coverage also has a consistently negative effect on length of stay for women who undergo BCS, the declines are only statistically significant in California (6.5%) and New York (20%). No consistent pattern emerges regarding length of stay for women designated as self-pay.

VII. DISCUSSION

The goal of this study was to provide information pertinent to three questions. Do breast cancer patients enrolled in HMOs receive a different pattern of care compared to women with other types of private insurance? Does proximity to a hospital with an ACS-approved cancer program influence the use of breast conserving surgery? Do women's decisions about where to receive care reflect either their preferences for one type of procedure or the other, or the effects of possible differences in the perceived quality of nearby and distant hospitals? We chose to focus these questions on nonelderly women with breast cancer because breast cancer is the most common cancer and the second leading cause of death in women.

To address these questions we analyzed the influence of economic and other nonclinical factors on treatment choice for breast cancer (BCS versus MRM) among women aged 40 to 64. We also examined, given treatment choice, two dimensions of quality of care, use of an ACS-approved cancer center and bypassing the nearest cancer center, and resource use as proxied by length of stay. The data were extracted from inpatient hospital discharges for the years 1988 and 1991 from five states which differ in the degrees of competition and regulation, and the growth of HMOs in the health care marketplace. While California is regarded as a highly competitive non-regulated market, the other four states--Maryland, Massachusetts, New Jersey and New York--have been subject to more stringent health care regulations including hospital rate setting initiatives. A second interesting contrast among these states is that California and New York are geographically large and encompass many urban and rural areas. The large geographic size of both states means that travel distance between a rural community and the nearest urban area may be quite substantial. By comparison, this situation is much less likely to occur in Maryland, Massachusetts, and New Jersey, which span much smaller geographic areas so that most rural regions are within close proximity of metropolitan areas.

The results of our analyses imply that economic and other nonclinical factors are significant determinants of breast cancer treatment choice, quality of care and the hospital stay required to undergo the alternative procedures, and that the effects of these factors can vary from state to state. First, we find that insurance status, our proxy for money price, is a significant determinant of both treatment choice and length of stay. HMO enrollees in California, New York and New Jersey, are less likely to undergo BCS. This result does not appear related to the extent of HMO penetration, since Massachusetts and Maryland both have higher percentages of breast cancer patients covered by HMOs than in New York and New Jersey. Nevertheless, these results imply that at least some managed care plans in some markets may have different practice patterns for

specific procedures, or that financial incentives may cause HMOs to prefer one treatment protocol over another. For example BCS may be more costly than MRM if hospital payments are similar because of the cost of follow-up RT. As expected, for both surgical procedures women with HMO insurance have shorter hospital stays compared to those covered by either Blue Cross or private insurance. This finding is consistent with prior evidence showing that HMOs' patients generally have shorter hospital length of stay.

However, it does not appear that HMO enrollees are less likely than other privately insured women to use an ACS-approved cancer hospital. In fact, except for Massachusetts, HMO enrollees are more likely to use cancer hospitals. While much has been written about potential constraints on the range of hospitals available to HMO enrollees, these data do not suggest that HMOs' breast cancer patients are constrained to use or directed to lower quality hospitals, at least by this measure, than privately insured patients. The fact that Massachusetts is different may reflect the greater availability of good quality cancer care in hospitals that do not have an ACS-approved cancer center. For example, the Dana Farber Cancer Institute in Boston is not an ACS-approved cancer hospital.

The only evidence suggesting a possible constraint on HMOs' breast cancer patients' choices are the findings that in California and New York, the two largest states in this analysis, HMO patients are less likely to bypass the nearest cancer center than are other privately insured women. Patients in these two states who lived more than 15 miles from a cancer center also had much higher relative odds of bypassing the nearest cancer hospital than did patients in the other three and geographically smaller states. Whether these effects are due to the characteristics of HMOs or the combination of where HMO enrollees live relative to the nearest cancer centers cannot be determined without further analyses.

Overall, these results suggest the possible existence of significant differences in breast cancer treatment choices and resources used by HMO enrollees and other privately insured patients. However, these differences are not uniform across the five states analyzed. More data on both the characteristics of the HMOs and the local market environments in which they operate are needed to provide clearer answers to the question of whether it is HMO enrollment or some other unmeasured factor that causes the differences observed. In addition, only data that track breast cancer patients over time and collect information on their survival and quality of life will be able to answer whether the observed differences reflect greater efficiency in providing care or the provision of lower quality care.

In general, it appears that Medicaid beneficiaries and self pay patients are less likely to receive BCS relative to those with either Blue Cross or private insurance. The lower use of BCS among women with less generous insurance coverage may occur because the total costs of an episode of care for MRM may be less expensive than the episode costs of BCS and follow-up radiation therapy. Such disparities may also arise if low Medicaid fees or lack of insurance coverage restricts the ability of Medicaid and self-pay patients to obtain physician care that is required after BCS. Further, since BCS is deemed inappropriate for stage III or IV cancers, diagnosis of advanced stage cancers among women with less generous insurance may also account for the variations in treatment choice. No consistent pattern emerges for either Medicaid beneficiaries or self-pay patients regarding the odds of receiving breast cancer surgery at a cancer hospital or whether such women opt to bypass the nearest cancer hospital. Irrespective of surgical procedure, Medicaid women require longer hospital stays than those with either Blue Cross or private insurance. The longer stays that characterize Medicaid women may be linked to comorbidities, disabilities or poor health status.

The study's findings with respect to the effects of travel distance also provide evidence regarding women's preferences and the role of perceived quality in seeking care for breast cancer. In California and New York, the two geographically largest states in the study, living more than 15 miles from the nearest cancer center reduced the relative odds of receiving BCS. However, women who bypassed the nearest cancer center were slightly, though significantly more likely to receive BCS. Together, these findings suggest the diffusion of the NIH recommendations to geographically remote areas may be slower than in more populated areas. Moreover, the perceived quality of care or the perceived ability to obtain BCS is not uniform across cancer hospitals, since women who bypass the nearest cancer hospital are more likely to receive BCS and the hospital where they receive treatment is both larger and has more medical residents than their nearby cancer hospital.

Finally, the finding that such a high proportion of women bypass the nearest cancer hospital also suggests that there is an active choice process taking place in making decisions about care for breast cancer. This is especially evident from the large relative odds associated with the use of a cancer hospital and the decision to bypass the nearest cancer hospital for women who live more than 15 miles from a cancer hospital. Since these women are most likely to live in either rural areas or the fringes of metropolitan areas, these high relative odds suggest that they seek care from hospitals of the highest perceived quality, which are more likely to be located in urban centers and, therefore, require bypassing the nearest hospital that has an ACS-approved cancer program. Obviously, the fact that breast cancer care is not provided under an emergency situation allows patients to select or "shop for" a place to receive care. These findings indicate that patients engage in such shopping behavior.

Although our findings based on five diverse, highly populated states offer new insights as to the effects of economic and other nonclinical factors on treatment choice for breast cancer, our

results are hampered by some limitations. First, data on outpatient procedures and the costs of radiation therapy treatments that accompany BCS are not available. If the monetary costs of the copayment, time costs and travel distance required to obtain a course of radiation therapy are substantial, a woman may be more likely to undergo a mastectomy, which is an inpatient procedure. While we were able to include outpatient data for New Jersey and did not find evidence of significant biases due to their exclusion, these inferences do not necessarily apply to other states and should be verified when the appropriate data become available.

A second limitation stems from the lack of information on disease stage. Women in our samples who received mastectomies may have opted for this surgical procedure because they had more advanced cancers for which BCS is inappropriate. The proxy used in our analyses, a diagnosis or procedure code indicating lymph node involvement, is not a direct indicator of disease stage.

A third potential limitation arises from the use of education at the ZIP code level as a proxy for each individual's educational attainment. Fourth, we have no information on each woman's wage rate, which varies considerably across individuals. Failure to control for the opportunity cost of time could yield biased time price effects. A fifth consideration relates to the strict inclusion/exclusion criteria we employed. Although we followed the inclusion/exclusion criteria of Nattinger et al. (1992), it is often difficult to compare surgical rates among studies due to differences in data sources and sample construction. Sixth, although the results are probably generalizable because they are based on the population of discharges, we cannot rule out the existence of selection bias due to unobserved differences in underlying health status. Finally, we cannot control for physician characteristics and preferences which may influence a woman's treatment choice.

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Table 1

Definitions of Variables

Variable	Definition
MEDICAID	= 1 if insurance coverage is Medicaid = 0 otherwise.
HMO	= 1 if insurance coverage is health maintenance organization, managed care plan; = 0 otherwise.
SELFPAY	= 1 if self-pay, uninsured or no charge; = 0 otherwise.
DISTNC15	= 1 if distance from patient's zip code of residence to nearest hospital with an ACS-approved cancer program is greater than 15 miles; = 0 otherwise.
DIST15	= 1 if distance from patient's zip code of residence to hospital where treatment was received is greater than 15 miles; = 0 otherwise.
EDUC2	= 1 if the proportion of persons residing in the patient's zip code of residence with at least a bachelor's degree is at least 15.2% but less than 21.5 % (California); the range of Maryland, Massachusetts and New Jersey is at least 14.7% but less than 20.1% the range for New York is at least 14% but less than 19.1%;= 0 otherwise.
EDUC3	= 1 if the proportion of persons residing in the patient's zip code of residence with at least a bachelor's degree is at least 21.5% but less than 29.7% (California); the range for Maryland, Massachusetts and New Jersey is at least 20.1% but less than 29.0% the range for New York is at least 19.1% but less than 26.5% = 0 otherwise.
EDUC4	= 1 if the proportion of persons residing in the patient's zip code of residence with at least a bachelor's degree is greater than or equal to 29.7% (California) the cutoff is 29% for (Maryland, Massachusetts, New Jersey) the cutoff is 26.5% for New York; = 0 otherwise.
YR	= 1 if year of surgery is 1991; equals 0 if year of surgery is 1988.
BLACK	= 1 if race is black; = 0 otherwise.
HISPAN	= 1 if ethnicity is hispanic; = 0 otherwise (California only)
ASIAN	= 1 if race is asian; = 0 otherwise (California only)

Table 1 (Continued)

OTHER	= 1 if race is other than white, black, hispanic or asian in California; = 1 if race is other than black or white for Maryland, Massachusetts and New Jersey; = 0 otherwise.
AGE	= age of respondent in years.
DRLNE	= 1 if ICD-0 diagnosis code is 196.3 (axillary lymph involvement); 0 otherwise.
CANCER	= 1 if hospital has a cancer program approved by the American College of Surgeons; = 0 otherwise.
BYPASS	= 1 if person bypasses the nearest cancer hospital to receive treatment at a more distant hospital; = 0 otherwise.
RRADIA	Radiation oncologists per 10,000 people in the county of residence.
COMB2	=1 if patient has 2 or moe comorbidities; = 0 otherwise.

Table 2

Means for Dependent and Key Independent Variables, by State

	California	New York	Maryland	Massachusetts	New Jersey
Percent BCS	23.7%	41.1%	21.2%	37.5%	37.5%
Bypass Nearest Cancer Hospital					
BCS	65.5%	73.2%	44.0%	68.8%	54.1%
MRM	63.1	66.2	45.3	64.0	52.4
Use a Cancer Hospital					
BCS	60.6%	59.6%	28.3%	79.2%	63.9%
MRM	58.6	51.1	32.7	76.8	67.3
Length of Stay					
BCS	2.1	2.4	2.5	2.1	2.1
MRM	2.7	5.2	3.9	3.7	3.7
Insurance					
Blue Cross/ Commercial	46.6%	82.9%	76.7%	72.4%	83.2%
HMO	39.7	6.2	13.7	20.0	8.3
Medicaid	6.8	7.6	6.1	4.0	3.3
Self-Pay	6.9	3.3	3.5	3.7	5.2
Distance to Nearest Cancer Hospital					
% <15 miles	85.0%	86.9%	71.4%	86.7%	96.1%
% >15 miles	15.0	13.1	28.6	13.3	3.9
Distance to Treatment Hospital					
% <15 miles	77.6%	75.5%	75.7%	72.2%	88.1%
% >15 miles	22.4	24.5	24.3	27.8	11.9

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Table 3
Regression Models (Parameter Estimates) for California

	Dependent Variables			
	BCS vs. MRM[a]	Use Cancer Hospital[b,c]	Bypass Nearest Cancer Hospital[b,c]	Length of Stay[b,d]
EDUC2	0.115**	0.228*	0.228*	-0.001
EDUC3	0.125*	0.200*	0.515*	0.005
EDUC4	0.275*	0.006	0.263*	-0.016
BLACK	0.111	-0.527*	-0.700*	0.130*
HISPAN	-0.110	-0.092	-0.234*	0.076*
ASIAN	-0.498*	0.099	-0.416*	0.025
OTHER	-0.168	-0.336*	-0.594*	0.009
CANCER	0.006	--	--	-0.038
MEDICAID	-0.397*	0.529*	-0.063	0.194*
SELFPAY	-0.364*	0.091	-0.293*	0.030
HMO	-0.195*	0.581	-0.159*	-0.094*
COMB2	0.286*	0.082**	-0.059	0.140*
BYPASS	0.076**	--	--	0.058*
RRADIA	0.670**	-0.010	-1.40*	--
AGE	-0.029*	0.001	0.007	0.001
YR	0.266*	0.070**	-0.005	-0.230*
DISTINC15	-0.111**	1.83*	1.38*	--
DIST15	--	--	--	0.026*
DRLNE	-0.960*	0.134*	0.128*	-0.021**
N	13,655	10,415	10,415	10,390
-2 LOG L	14,436	12,944	12,800	--
CHI SQUARE	528	1,186	915	--
R^2	--	--	--	0.096

* $p \leq .05$
** $.05 < p \geq .10$
a. All breast cancer patients
b. Women with modified radical mastectomy only.
c. Hospital with a cancer program approved by the American College of Surgeons.
d. National log of the length of stay.

Table 4

Effects of Insurance Coverage and Travel Distance on the
Relative Odds of Breast Conserving Surgery,
Women between 40 and 64 Years Old, by State

Variable	State					
					New Jersey	
	California	New York	Massachusetts	Maryland	Includes Outpatient	Excludes Outpatient
Insurance Coverage[a]						
HMO	0.82*	0.84*	1.09	1.04	0.79**	0.81**
Medicaid	0.67*	0.80*	1.00	0.84	1.42**	1.40**
Self-Pay	0.70*	0.87*	0.72**	0.87	0.72*	0.73*
Distance of More Than 15 Miles to Nearest Cancer Hospital[b]	0.90**	0.78*	0.94	1.22**	0.99	0.98
Women Who Bypass the Nearest Cancer Hospital[c]	1.08**	1.22*	1.14	1.01	0.91	0.91

*$p \leq .05$
**$.05 < p \leq .10$
a. Reference group is women with Blue Cross or commercial indemnity insurance.
b. Reference group is women within 15 miles of a "cancer" hospital, which has a cancer program approved by The American College of Surgeons.
c. Reference group is women who are treated at either the nearest cancer hospital or another nearby hospital.

Table 5

Effects of Insurance Coverage and Travel Distance on the Relative Odds of Using a Cancer Hospital, Women between 40 and 64 Years Old, by State and Surgical Procedure

Variable	State					
					New Jersey	
	California	New York	Massachusetts	Maryland	Includes Outpatient	Excludes Outpatient
Women Who Received Breast Conserving Surgery						
Insurance Coverage[a]						
HMO	2.20*	1.30*	0.89	1.76**	1.29*	1.15
Medicaid	1.16	0.66*	1.34	0.57	1.52*	1.20
Self-Pay	1.08	1.29	0.70	0.67	0.50*	0.82
Distance of More Than 15 Miles to Nearest Cancer Hospital[b]	5.77*	3.21*	3.92*	1.97*	4.37*	5.15*
Women Who Received Modified Radical Mastectomy						
Insurance Coverage[a]						
HMO	1.79*	1.98*	0.71*	3.37*	1.34*	1.35*
Medicaid	1.70*	0.78*	1.37	1.10	1.21	1.21
Self-Pay	1.10	1.63*	1.31	0.79	1.13	1.15
Distance of More Than 15 Miles to Nearest Cancer Hospital[b]	6.21*	3.48*	2.97*	2.31*	5.41*	5.38*

*$p \leq .05$

**$.05 < p \leq .10$

a. Reference group is women with Blue Cross or commercial indemnity insurance.

b. Reference group is women within 15 miles of a "cancer" hospital, which has a cancer program approved by The American College of Surgeons.

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Table 6

Effects of Insurance Coverage and Travel Distance on the
Relative Odds of Bypassing the Nearest Cancer Hospital,
Women between 40 and 64 Years Old, by State and Surgical Procedure

Variable	State					
					New Jersey	
	California	New York	Massachusetts	Maryland	Includes Outpatient	Excludes Outpatient
Women Who Received Breast Conserving Surgery						
Insurance Coverage[a]						
HMO	0.94	0.72*	1.24	1.05	1.10	1.00
Medicaid	0.87	1.76*	1.28	1.07	1.65*	2.27*
Self-Pay	0.69*	1.32	2.10*	0.54	0.90	1.27
Distance of More Than 15 Miles to Nearest Cancer Hospital[b]	3.62*	4.53*	1.72*	2.66*	2.86*	3.12*
Women Who Received Modified Radical Mastectomy						
Insurance Coverage[a]						
HMO	0.85*	0.81*	1.23**	1.03	1.42*	1.42*
Medicaid	0.94	1.80*	1.96*	1.02	2.59*	2.58*
Self-Pay	0.75*	1.18	1.66*	1.18	1.50*	1.50*
Distance of More Than 15 Miles to Nearest Cancer Hospital[b]	3.96*	4.32*	1.63*	2.38*	2.26*	2.26*

*$p \leq .05$
**$.05 < p \leq .10$
a. Reference group is women with Blue Cross or commercial indemnity insurance.
b. Reference group is women within 15 miles of a "cancer" hospital, which has a cancer program approved by The American College of Surgeons.

Table 7

Characteristics of Bypassed Cancer Center and
Cancer Center Actually Used, by State

	State				
	California	New York	Massachusetts	Maryland	New Jersey[a]
Total Patients[b]	13,655	14,091	3,627	2,835	4,435
Percent Receiving Care from a More Distant Cancer Center	63.7	69.1	65.8	45.0	53.6
Hospital Size (Beds)					
Bypassed Cancer Center	257	430	246	309	364
Cancer Center Used	349	583	390	417	404
Number of Residents					
Bypassed Cancer Center	18	72	20	23	30
Cancer Center Used	49	180	144	44	39

a. Excludes outpatients.
b. BCS and MRM patients.

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Table 8

Effects of Insurance Coverage on Inpatient Length of Stay,
Women between 40 and 64 Years Old, by
State and Surgical Procedure

Variable	State				
	California	New York	Massachusetts	Maryland	New Jersey[b]
Women Who Received Breast Conserving Surgery					
Insurance Coverage[a]					
HMO	-0.063*	-0.201*	-0.070	-0.039	-0.101
Medicaid	0.379*	0.352*	0.572*	0.650*	0.575*
Self-Pay	0.029	0.083	0.237*	0.076	0.053
Women Who Received Modified Radical Mastectomy					
Insurance Coverage					
HMO	-0.094*	-.128*	-0.070*	-0.069*	-0.062**
Medicaid	.194*	0.258*	0.107**	0.198*	0.388*
Self-Pay	0.030	-0.069*	0.054	0.059	0.110*

a. Percentage difference relative to women with Blue Cross or commercial indemnity insurance.
b. Excludes outpatient cases.

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APPENDIX

Complete Regression Models

Appendix Table 1

Choice of Breast Conserving Surgery vs. Modified Radical Mastectomy,
Women between 45 and 64 Years of Age, by State
(logistic regression coefficients)

	State					
					New Jersey	
Variable	California	New York	Mass	Maryland	Includes Outpatient	Excludes Outpatient
EDUC2	0.115**	0.066	0.092	0.153	-0.047	-0.053
EDUC3	0.125*	0.138*	0.125	0.023	0.069	0.077
EDUC4	0.275*	0.189*	-0.059	-0.097	0.001	0.012
BLACK	0.111	0.199*	0.162	-0.054	0.147	0.165
HISPAN	-0.110	0.176*				
ASIAN	-0.498*					
OTHER	-0.168	-0.351*	0.115	-0.529	0.042	0.076
CANCER	0.006	0.238*	0.055	-0.218*	0.066	0.076
MEDICAID	-0.397*	-0.219*	-0.003	-0.179	0.351**	0.335**
SELFPAY	-0.364*	-0.142	-0.333**	-0.139	-0.329*	-0.318*
HMO	-0.195*	-0.175*	0.086	0.043	-0.233**	-0.210**
COMB2	0.286*	0.112*	0.190*	0.464*	0.374*	0.397*
BYPASS	0.076**	0.195*	0.127	0.013	-0.096	-0.098
RRADIA	0.670**	-0.034	0.462*	-0.052	0.538	0.517
AGE	-0.029*	-0.030*	-0.015*	-0.030*	-0.033*	-0.034*
YR	0.266*	-0.352*	0.223*	0.239*	-0.005	-0.014
DISTINC15	-0.111**	-0.244*	-0.061	0.197**	-0.010	-0.025*
DRLNE	-0.960*	-1.657*	-0.994*	-1.415*	-1.584*	-1.595*
NOADMIT					6.228*	
N	13655	14091	3627	2835	11104	4435
-2 LOG L	14436	17514	4652	2788	5649	5396
CHI SQUARE	528	1575	145	139	6959	428

*$p \leq .05$
**$.05 < p \leq .10$

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Appendix Table 2a

Use of a Cancer Hospital, Women with Breast Conserving Surgery,
Ages 45 to 64, by State
(logistic regression coefficients)

Variable	State					
					New Jersey	
	California	New York	Mass	Maryland	Includes Outpatient	Excludes Outpatient
EDUC2	0.233*	-0.233*	0.153	-0.027	0.185*	0.284**
EDUC3	0.156	-0.383*	-0.118	0.589*	-0.260*	-0.416*
EDUC4	-0.103	-0.659*	-0.716*	0.298	-0.573*	-0.882*
BLACK	0.153	-0.046	0.065	0.236	0.436*	0.581*
HISPAN	0.213	0.483*				
ASIAN	0.528*					
OTHER	-0.674**	-0.095	1.424*	-0.838	0.675*	0.618*
MEDICAID	0.146	-0.421*	0.295	-0.559	0.421*	0.183
SELFPAY	0.079	0.256	-0.351	-0.399	-0.689*	-0.194
HMO	0.788*	0.269*	-0.120	0.565**	0.251*	0.142
COMB2	0.133	0.174*	0.076	0.221	-0.080	0.060
RRADIA	1.910*	0.869*	-0.085	1.220**	-0.407	1.101
AGE	-0.004	0.004	0.006	-0.016	0.007*	0.008
YR	-0.141**	0.193*	-0.421*	0.120	-0.252*	-0.241*
DISTINC15	1.753*	1.167*	1.366*	0.677*	1.475*	-1.638*
DRLNE	-0.165	-0.325*	-0.236	-0.524	-0.466*	-0.474*
NOADMIT					0.314*	
N	3240	5796	1359	600	8273	1622
-2 LOG L	4002	7512	1270	686	10262	1882
CHI SQUARE	341	309	121	30	556	145

*$p \leq .05$
**$.05 < p \leq .10$

Appendix Table 2b

Use of a Cancer Hospital, Women with Modified Radical Mastectomy, Ages 45 to 64, by State (logistic regression coefficients)

Variable	State					
					New Jersey	
	California	New York	Mass	Maryland	Includes Outpatient	Excludes Outpatient
EDUC2	0.228*	-0.319*	-0.066	-0.059	-0.015	-0.030
EDUC3	0.200*	-0.472*	-0.375*	0.552*	-0.487*	-0.510*
EDUC4	0.006	-0.429*	-0.618*	0.351*	-1.025*	-1.051*
BLACK	-0.527*	-0.258*	0.647*	0.043	0.297*	0.268*
HISPAN	-0.092	0.370*				
ASIAN	0.099					
OTHER	-0.336*	-0.513*	1.022*	0.034	0.677*	0.665*
MEDICAID	0.529*	-0.249*	0.316	0.092	0.186	0.192
SELFPAY	0.091	0.489*	0.272	-0.232	0.125	0.136
HMO	0.581*	0.683*	-0.346*	1.216*	0.295*	0.297*
COMB2	0.082	-0.144*	0.006	-0.218*	-0.013	-0.007
RRADIA	-0.011	0.551*	0.111	1.135*	0.933	0.965**
AGE	0.001	0.011*	0.003	0.017*	0.002	0.001
YR	0.070	0.055	-0.545*	-0.128	-0.213*	-0.219*
DISTINC15	1.827*	1.247*	1.089*	0.837*	1.687*	-1.683*
DRLNE	0.134*	0.141*	0.093	0.323*	-0.023	-0.025
NOADMIT					-0.158	
N	10415	8295	2268	2235	2831	2813
-2 LOG L	12944	10883	2294	2684	3353	3334
CHI SQUARE	1186	613	165	141	224	222

*$p \leq .05$
**$.05 < p \leq .10$

Appendix Table 3a

Bypass Nearest Cancer Hospital, Women with Breast Conserving Surgery, Ages 45 to 64, by State
(logistic regression coefficients)

Variable	State					
					New Jersey	
	California	New York	Mass	Maryland	Includes Outpatient	Excludes Outpatient
EDUC2	0.265*	-0.055	0.217	-0.213	0.111**	0.277**
EDUC3	0.379*	-0.101	-0.560*	0.255	0.147*	0.423*
EDUC4	0.379*	-0.603*	-0.572*	-0.022	0.289*	0.319*
BLACK	-0.093	-0.189**	-0.422	0.179	-0.156*	0.133
HISPAN	-0.104	-0.363*				
ASIAN	-0.636*					
OTHER	0.015	-0.344**	0.545*	0.669	-0.037	0.207
MEDICAID	-0.142	0.568*	0.248	0.070	0.500*	0.820*
SELFPAY	-0.371*	0.277	0.739*	-0.614	-0.102	0.236
HMO	-0.057	-0.335*	0.211	0.051	0.091	-0.002
COMB2	-0.059	0.011	0.077	0.145	-0.019	0.226**
RRADIA	-1.646*	2.069*	-1.644*	-1.990*	-1.082*	-0.506
AGE	0.011*	0.013*	0.026*	0.007	0.017*	0.026*
YR	-0.005	-0.020	-0.165	-0.097	-0.093	-0.422*
DISTINC15	1.286*	1.511*	0.544*	0.979*	1.051*	1.139*
DRLNE	-0.012	-0.246*	-0.201	-0.664**	-0.053	-0.085
NOADMIT					-0.121**	
N	3240	5796	1359	600	8273	1622
-2 LOG L	3979	6350	1592	752	11244	2183
CHI SQUARE	198	390	95	71	170	66

*$p \leq .05$
**$.05 < p \leq .10$

Appendix Table 3b

Bypass Nearest Cancer Hospital, Women with
Modified Radical Mastectomy, Ages 45 to 64, by State
(logisitc regression coefficients)

Variable	State					
					New Jersey	
	California	New York	Mass	Maryland	Includes Outpatient	Excludes Outpatient
EDUC2	0.228*	0.057	-0.170	-0.030	0.023	0.030
EDUC3	0.515*	-0.160*	-0.820*	0.468*	0.065	0.070
EDUC4	0.263*	-0.419*	-0.757*	0.124	0.119	0.123
BLACK	-0.700*	-0.449*	-0.098	-0.137	0.069	0.060
HISPAN	-0.234*	-0.677*				
ASIAN	-0.416*					
OTHER	-0.594*	-0.692*	0.299	0.103	-0.230	-0.221
MEDICAID	-0.064	0.587*	0.675*	0.019	0.950*	0.949*
SELFPAY	-0.293*	0.167	0.509*	0.167	0.407*	0.408*
HMO	-0.159*	-0.206*	0.208**	0.030	0.349*	0.351*
COMB2	0.059	-0.272*	0.005	-0.062	-0.107	-0.084
RRADIA	-1.399*	0.661*	-1.841*	-1.221*	-1.172*	-1.230*
AGE	0.007*	0.016*	0.025*	0.008	0.010**	0.009**
YR	-0.006	-0.012	-0.289*	-0.096	-0.366*	-0.369*
DISTINC15	1.375*	1.463*	0.488*	0.867*	0.815*	0.815*
DRLNE	0.128*	0.152*	0.134	0.067	-0.010	-0.019
NOADMIT					0.026	
N	10415	8295	2268	2235	2831	2813
-2 LOG L	12800	9810	2783	2918	3846	3821
CHI SQUARE	915	800	181	161	72	72

*$p \leq .05$
**$.05 < p \leq .10$

Appendix Table 4a

Length of Stay[a], Women with Breast Conserving Surgery
45 to 64 Years of Age, by State
(regression coefficients)

Variable	State				
	California	New York	Massachusetts	Maryland	New Jersey[b]
EDUC2	-0.010	-0.042	-0.084	-0.037	-0.019
EDUC3	-0.018	-0.013	-0.059	-0.042	-0.058
EDUC4	-0.065**	0.042	-0.100**	-0.060	-0.029
BLACK	0.156*	0.133*	0.030	0.108	0.426*
HISPAN	0.045	-0.006			
ASIAN	0.119*				
OTHER	0.120	-0.194*	-0.015	0.085	-0.023
MEDICAID	0.380*	0.348*	0.571*	0.658*	0.576*
SELFPAY	0.031	0.082	0.237*	0.099	0.056
HMO	-0.063*	-0.201*	-0.071	-0.039	-0.101
COMB2	0.400*	0.259*	0.261*	0.325*	0.418*
AGE	0.001	0.009*	0.009*	0.000	0.009*
YR	-0.150*	0.208*	-0.244*	-0.185*	0.082**
BYPASS	0.026	0.018**	-0.032	-0.002	-0.040
CANCER	-0.025	0.136*	0.124*	0.011	0.014
DIST15	-0.036	-0.017	-0.061	-0.088	0.082
DRLNE	-0.252*	0.303*	-0.097	-0.066	0.167*
N	3111	5795	1358	594	1621
ADJ. R^2	0.1329	0.0956	0.1073	0.1167	0.1178

*$p \leq .05$
**$.05 < p \leq .10$
a. Dependent Variable is the natural logarithm of the length of stay.
b. Excludes Outpatients.

Appendix Table 4b

Length of Stay[a], Women with Modified Radical Mastectomy Surgery,
45 to 64 Years of Age, by State
(regression coefficients)

Variable	State				
	California	New York	Massachusetts	Maryland	New Jersey[b]
EDUC2	-0.001	-0.011	0.003	0.046	-0.067*
EDUC3	0.005	-0.003	-0.010	0.023	-0.107*
EDUC4	-0.016	0.044*	-0.010	0.071*	-0.079*
BLACK	0.130*	0.231*	0.202*	0.158*	0.162*
HISPAN	0.076*	0.139*			
ASIAN	0.025				
OTHER	0.009	0.065*	0.020	0.080	0.028
MEDICAID	0.194*	0.258*	0.107**	0.198*	0.392*
SELFPAY	0.030	-0.069*	0.054	0.055	0.109*
HMO	-0.094*	-0.128*	-0.070*	-0.069*	-0.061**
COMB2	0.140*	0.202*	0.173*	0.163*	0.195*
AGE	0.001	0.004*	0.002	0.001	0.005*
YR	-0.231*	-0.225*	-0.293*	-0.259*	-0.192*
BYPASS	0.058*	0.093*	0.054*	0.020	0.042*
CANCER	-0.038*	0.181*	-0.020	-0.043*	-0.070*
DIS15	-0.027*	0.004	0.003	0.067*	-0.076*
DRLINE	-0.021	0.029*	0.013	0.029	0.023
N	10390	8294	2267	2234	2812
ADJ R^2	.0963	0.1936	0.1101	0.1299	0.1309

*$p \leq .05$
**$.05 < p \leq .10$
a. Dependent Variable is the natural logarithum of the length of stay.
b. Excludes Outpatient.